REMARKS

Claims 1-5, 7-14, 17-33, 35-48 and 51-56 are pending in this application.

Claims 1-5, 7, 8, 10, 11, 13, 14, 17-24, 26, 27, 29-33, 35-43, 46, 48, 49 and 51-56 are not properly rejected under 35 U.S.C. § 103 as being unpatentable over Wang et al. (U.S. Patent No. 5,607,874) ("Wang") in view of Yamazaki et al. (U.S. Patent No. 5,840,600) ("Yamazaki")

Claims 1-5, 7, 8, 10, 11, 13, 14, 17-24, 26, 27, 29-33, 35-43, 46, 48, 49 and 51-56 stand rejected under 35 U.S.C. § 103 as being unpatentable over Wang in view of Yamazaki. This rejection is respectfully traversed.

The claimed invention relates to a method of forming a composite barrier layer between a glass insulating layer and active regions of a memory device. As such, independent claim 1 recites a "method of forming an integrated structure" by *inter alia* "forming at least one gate stack structure over a substrate," "forming a source/drain region in said substrate on opposite sides of said gate stack structure" and "subsequently forming an oxide layer over said source/drain region, said oxide layer having a thickness of about 50 Angstroms to about 100 Angstroms and being formed by oxidizing approximately an upper surface of said source/drain region using atomic oxygen at a temperature of about 850 ^{0}C to 1100 ^{0}C." Independent claim 1 also recites "forming a barrier layer in contact with said oxide layer."

Independent claim 21 recites a "method for forming a memory cell" by *inter alia* "forming a plurality of gate stacks over a substrate, each of said plurality of gate stacks comprising a gate oxide layer and a conductive layer," "forming spacers on sidewalls of each of said plurality of gate stacks" and "forming source/drain regions in said substrate on opposite sides of each of said plurality of gate stacks." Independent

claim 21 also recites "subsequently forming a composite barrier layer over said source/drain regions and said plurality of gate stacks, said composite barrier layer comprising an oxide layer formed by oxidizing approximately entire upper surfaces of said source/drain regions using atomic oxygen so that said oxide layer has a first oxide portion of a first thickness over said spacers and a second oxide portion over said source/drain regions of a second thickness, said second thickness being greater than said first thickness." Independent claim 21 further recites that the composite barrier layer comprises "a barrier layer formed over said oxide layer." Independent claim 21 also recites "forming a glass insulating layer in contact with said composite barrier layer."

Independent claim 40 recites a "method of preventing the diffusion of atoms from a glass insulating layer in to a source/drain region formed between adjacent gate stacks of a memory device" by *inter alia* "forming spacers on sidewalls of said gate" and "subsequently forming a composite barrier layer over said source/drain region." Independent claim 40 further recites that the composite barrier layer comprises "an oxide layer formed to a thickness of about 50 Angstroms to about 100 Angstroms by oxidizing approximately an entire upper surface of said source/drain region using atomic oxygen so that said oxide layer has a first oxide portion of a first thickness over said spacers and a second oxide portion over said source/drain regions of a second thickness, said first thickness being about 60% of said second thickness." Independent claim 40 further recites "a barrier layer formed over said oxide layer."

Wang relates to "a method for fabricating a T or Y shaped capacitor which has less photolithographic and etch steps than the conventional processes." (Col. 2, lines 28-31). For this, Wang teaches the formation of several gate stacks over a substrate and of a source and drain region. (Col. 4). Wang also teaches the formation of an oxide

layer (col. 5, lines 11-17) and of a barrier layer over source/drain regions. (Col. 5, lines 29-35).

Yamazaki relates to a method for "improv[ing] the characteristic properties of a silicon oxide film deposited by PVD or CVD." (Col. 3, lines 11-13). For this, Yamazaki teaches the steps of "forming a thermal oxidation film by oxidation of silicon film at 500°-700° C. or . . . forming an insulating film composed mainly of silicon oxide which is deposited by PVD or CVD so as to cover island-like crystalline silicon, and then . . . annealing the resulting film at 400°-700° C. in a highly reactive atmosphere of nitrogen oxide which is photoexcited or photodecomposed by ultraviolet rays." (Col. 3, lines 14-21). In this manner, "[t]he thus modified silicon oxide film is used as the gate insulating film." (Col. 3, lines 21-22).

Applicants are surprised at the failure of the April 6, 2005 Office Action to recognize that the subject matter of claims 1-8, 10, 11, 13, 14, 17-24, 26, 27, 29-33, 35-43, 46, 48, 49 and 51-56 would not have been obvious over Wang in view of Yamazaki. Applicants reemphasize that the Office Action simply fails to establish a *prima facie* case of obviousness. To establish a *prima facie* case of obviousness, three requirements must be met: (1) some suggestion or motivation, either in the references themselves or in the knowledge of a person of ordinary skill in the art, to modify the reference or combine reference teachings; (2) a reasonable expectation of success; and (3) the prior art reference (or references when combined) must teach or suggest all the claim limitations. More importantly, the teaching or suggestion to make the claimed combination and the reasonable expectation for success must both be found in the prior art and not based on Applicant's disclosure. See, e.g., In re Royka, 490 F.2d 981, 180 U.S.P.Q. 580 (CCPA 1974). The Examiner has the burden of producing a *prima facie* case of obviousness.

A. The References do not Teach or Suggest the subject Matter of Claims 1-5, 7, 8, 10, 11, 13, 14, 17-24, 26, 27, 29-33, 35-43, 46, 48, 49 and 51-56

First, Wang nor Yamazaki, whether considered alone or in combination, fail to disclose, teach or suggest all limitations of amended independent claims 1, 21 and 40, and of dependent claims 2-5, 7, 8, 11, 13, 14, 17-20, 22-24, 26, 27, 29-33, 35-39, 41-43, 46, 48, 49 and 51-56.

Claims 1-5, 7, 8, 10, 11, 13, 14 and 17-20

Neither Wang nor Yamazaki discloses, teaches or suggests "forming an oxide layer . . . having a thickness of about 50 Angstroms to about 100 Angstroms . . . by oxidizing an upper surface of said source/drain region using atomic oxygen at a temperature of about 850 °C to 1100 °C," as independent claim 1 recites. Wang is silent about forming an oxide layer by oxidizing an upper surface of a source/drain region using atomic oxygen, much less about forming an oxide layer "having a thickness of about 50 Angstroms to about 100 Angstroms" by oxidizing approximately an upper surface of a source/drain region using atomic oxygen "at a temperature of about 850 °C to 1100 °C," as recited in independent claim 1. In fact, Wang teaches that conformal insulating layer 22, which would arguably correspond to the oxide layer of the claimed invention, has a thickness "in the range between about 500 and 3000 Å" (col. 5, lines 15-17), and not "of about 50 Angstroms to about 100 Angstroms," as in the claimed invention.

Yamazaki is also silent about "forming an oxide layer . . . by oxidizing an upper surface of said source/drain region using atomic oxygen," much less about "forming an oxide layer . . . having a thickness of about 50 Angstroms to about 100 Angstroms . . . by oxidizing an upper surface of said source/drain region using atomic

oxygen at a temperature of about 850 °C to 1100 °C," as independent claim 1 recites. Yamazaki teaches thermal oxidation of a silicon film 703 to form a silicon oxide film 704. (Col. 30, lines 11-14). Yamazaki does not disclose, teach or suggest, however, the formation of an oxide layer *"by oxidizing an upper surface of said source/drain region using atomic oxygen"* or *"by oxidizing approximately an entire upper surface of said source/drain region using atomic oxygen,"* as in the claimed invention (emphasis added). In addition, Yamazaki teaches that "a thermal oxidation film is formed by oxidation of silicon film at 500° to 700° C," and not by "oxidizing an upper surface of said source/drain region using atomic oxygen at a temperature of about 850 °C to 1100 °C," as in the claimed invention.

Applicants are surprised at the failure of the April 6, 2005 Office Action to recognize that Yamazaki simply fails to disclose an oxide layer formed *by oxidizing the upper surface of a source/drain region.* The assertion in the April 6, 2005 Office Action that "Yamazaki discloses forming an oxide layer by oxidizing the upper surface of the source/drain region using atomic oxygen (Column 12, Lines 14-27)" is unsupported. (April 6, 2005 Office Action at 3). Applicants reaffirm that, in column 12, lines 14-27, Yamazaki teaches only that "atomic oxygen and ozone (which are obtained by irradiating oxygen with ultraviolet rays for excitation, decomposition, and reaction) or excited oxygen molecules and nitrogen oxide molecules have a sufficiently long life and are capable of spatial movement under adequate conditions." However, nowhere in column 12 of Yamazaki is it disclosed or suggested that the oxide layer is formed *by oxidizing the upper surface of a source/drain region,* much less that the oxide layer is formed *by oxidizing the upper surface of a source/drain region using atomic oxygen,* as in the claimed invention. In Yamazaki, source and drain regions are not subjected to atomic oxygen, as in the claimed invention.

In fact, Yamazaki *could not* disclose, teach or suggest "forming an oxide layer . . . by oxidizing an upper surface of said source/drain region using atomic oxygen," as recited in independent claim 1. This is because Yamazaki teaches first the formation of the insulating film 15 and only then the formation of source/drain regions 17. (Col. 19, lines 56-67; Col. 20, lines 1-29; Figures 2B-2D). In fact, in Yamazaki, insulating film 15 (which would arguably correspond to the oxide layer of the claimed invention) is "used as the gate insulating film," and not as "an oxide layer over said source/drain regions" which in turn are formed "on opposite sides of said gate structure," as in the claimed invention. Accordingly, Yamazaki is silent about "forming a source/drain region" and "*subsequently* forming an oxide layer over said source/drain region . . . by oxidizing an upper surface of said source/drain region using atomic oxygen," as recited in independent claim 1.

Further, insulating film 15 of Yamazaki is "200-1500 Å thick, typically 1000 Å thick," and not having a minimal thickness "of about 50 Angstroms to about 100 Angstroms," as in the claimed invention. Applicants also note that "interlayer insulating film 18" of Yamazaki, which would also arguably correspond to the oxide layer of the claimed invention, is formed over "the entire surface" of the device and to a thickness of 3000 Å, and not by oxidizing source/drain regions or to a minimal thickness "of about 50 Angstroms to about 100 Angstroms," as in the claimed invention. Accordingly, Yamazaki does not teach or suggest forming an oxide layer by oxidizing upper surfaces of a source/drain region using atomic oxygen, much less forming an oxide layer of the claimed thickness by oxidizing upper surfaces of a source/drain region using atomic oxygen.

Claims 21-24, 26, 27, 29-33 and 35-39

Wang and Yamazaki, whether considered alone or in combination, also fail to teach or suggest all limitations of independent claim 21 and of dependent claims 22-24, 26, 27, 29-33 and 35-39. Wang and Yamazaki fail to teach or suggest forming "a composite barrier layer over said source/drain regions . . . comprising an oxide layer formed by oxidizing approximately entire upper surfaces of said source/drain regions using atomic oxygen so that said oxide layer has a first oxide portion of a first thickness over said spacers and a second oxide portion over said source/drain regions of a second thickness, said second thickness being greater than said first thickness," as independent claim 21 recites.

Both Wang and Yamazaki are silent about an oxide layer formed "by oxidizing approximately entire upper surfaces of said source/drain regions using atomic oxygen," as in the claimed invention. In addition, Wang teaches that etch barrier layer 24, which would arguably correspond to the barrier layer of the claimed invention, has a thickness "in the range between about 500 and 3000 Å" (col. 5, lines 32-34), and not "of about 30 Angstroms to about 150 Angstroms," as recited in claim 21. Yamazaki is silent about the formation of "a barrier layer . . . over said oxide layer," much less about the formation of "a barrier layer . . . over said oxide layer" and "having a thickness of about 30 Angstroms to about 150 Angstroms," as in the claimed invention.

Wang and Yamazaki, alone or in combination, also fail to teach or suggest "an oxide layer . . . ha[ving] a first oxide portion of a first thickness over said spacers and a second oxide portion over said source/drain regions of a second thickness, said second thickness being greater than said first thickness," as independent claim 21 recites. As noted, Wang teaches a conformal insulating layer 22, which would arguably

correspond to the oxide layer of the claimed invention, having a thickness "in the range between about 500 and 3000 Å," and not having "a first oxide portion of a first thickness over said spacers and a second oxide portion over said source/drain regions of a second thickness, said second thickness being greater than said first thickness," as in the claimed invention. Yamazaki is also silent about oxidizing upper surfaces of source/drain regions, much less about "oxidizing approximately entire upper surfaces of said source/drain regions using atomic oxygen so that said oxide layer has a first oxide portion of a first thickness over said spacers and a second oxide portion over said source/drain regions of a second thickness, said second thickness being greater than said first thickness," as in the claimed invention.

The April 6, 2005 Office Action admits that "neither Wang not Yamazaki discloses the thickness of the oxide layer being 50 to 100 Å," but asserts nevertheless that "the thickness of a layer, absent to evidence to the contrary, is a well known process variable and is only a matter of routine experimentation to find the workable or optimum ranges." (April 6, 2005 Office Action at 7). This assertion, that the thickness of the silicon oxide layer is a result effective parameter, is an unsupported assumption.

Courts have generally recognized the rule that the discovery of an optimum value of a variable in a known process is typically obvious. See e.g., In re Aller, 42 C.C.P.A. 824, 220 F.2d 454, 105 U.S.P.Q. 233 (1955). However, courts have found exceptions to this rule in cases where the results of optimizing a variable, which was known to be result effective, were unexpectedly good. For example, in In re Waymouth, 499 F.2d 1273, 1276, 182 U.S.P.Q. 290, 293 (CCPA 1974), the Court of Appeals held that unexpected results for a claimed range as compared with the range disclosed in the prior art had been shown by a demonstration of "a marked improvement, over the results achieved under other ratios." Evidence of unobvious or

unexpected advantageous properties, such as superiority in a property the claimed compound shares with the prior art can rebut prima facie obviousness. In re Chupp, 816 F.2d 643, 646 (Fed. Cir. 1987). Accordingly, a specific ratio of halogen to mercury for producing whiter light by a lamp was held by the Court to be "critical" for attainment of maximum white light emission, and the claimed ratio was not the result of obvious experimentation. In re Waymouth, 499 F.2d at 1276.

Under the holding of In re Waymouth, the thickness of the silicon oxide layer formed as part of the composite barrier layer provided directly over the source/drain regions would not have been obvious as the results are unexpectedly good. In the present invention, the thickness of the silicon oxide layer is small compared to that of the prior art and, in addition, the oxide layer has a first thickness on the source/drain region that is different from a second thickness on the gate spacers. As emphasized in the application, "oxide layer 93 (FIG. 14) is formed over the structure of FIG. 13, to a thickness of about 20 Angstroms to about 500 Angstroms, more preferably of about 50 Angstroms to about 100 Angstroms." (¶[0047]). In addition, the application teaches that "the thickness of the portions 93a (FIG. 14) of the oxide layer 93, that are formed over the spacers 62 of the gate stacks 70, is of about 60% of the targeted thickness of the portions 93b (FIG. 14) of the oxide layer 93, which are formed overlying the source/drain regions 93." (¶[0048]). The application further explains that the "thickness of the portions 93a, of about 60% of the targeted thickness, is very high compared to a typical resulting thickness in a conventional method, such as wet oxidation without utilizing atomic oxygen. In a conventional method, the resulting thickness of portions 93b is of about 1% to 3% of the targeted thickness of the portions 93a." (¶[0048]).

The thin oxide layer having different thicknesses on the spacers and the source/drain regions is advantageous to the invention as it "prevents . . . the diffusion of boron and/or phosphorous atoms from the glass insulating layer 97 into the source/drain regions 82 at high temperatures." (¶[0052]). In this manner, "since there is no glass insulating layer-source/drain regions interface, the migration of the boron and/or phosphorous atoms from the glass insulating layer 97 into the source/drain regions 82 and/or under the spacers 62 and into the LDD regions 72 is eliminated and the 'refresh time' of the device is not affected negatively." (¶[0052]). As these results are unexpected advantageous properties, the thin oxide layer having different thicknesses on the spacers and the source/drain regions is not a mere result of routine or obvious experimentation, as recognized by the Courts in <u>In re Waymouth</u> and <u>In re Antoine</u>.

<u>Claims 40-43, 46, 48, 49 and 51-56</u>

Wang and Yamazaki, alone or in combination, also fail to teach or suggest all limitations of independent claim 40, and of dependent claims 42-43, 46, 48, 49 and 51-56. Wang and Yamazaki fail to teach or suggest forming "forming a composite barrier layer . . . comprising an oxide layer formed to a thickness of about 50 Angstroms to about 100 Angstroms by oxidizing approximately an entire upper surface of said source/drain region using atomic oxygen," as independent claim 40 recites.

Wang is silent about forming an oxide layer by oxidizing an upper surface of a source/drain region using atomic oxygen, much less about forming an oxide layer "having a thickness of about 50 Angstroms to about 100 Angstroms" by oxidizing approximately an upper surface of a source/drain region using atomic oxygen, as in the claimed invention. Wang teaches that conformal insulating layer 22, which would arguably correspond to the oxide layer of the claimed invention, has a thickness "in the

range between about 500 and 3000 Å" (col. 5, lines 15-17), and not "of about 50 Angstroms to about 100 Angstroms," as in the claimed invention.

Similarly, Yamazaki is silent about "forming a composite barrier layer . . . comprising an oxide layer . . . by oxidizing approximately an entire upper surface of said source/drain region using atomic oxygen," as independent claim 40 recites. Yamazaki teaches thermal oxidation of a silicon film 703 to form a silicon oxide film 704. (Col. 30, lines 11-14). Yamazaki does not disclose, teach or suggest, however, the formation of an oxide layer *"by oxidizing an upper surface of said source/drain region using atomic oxygen"* or *"by oxidizing approximately an entire upper surface of said source/drain region using atomic oxygen,"* as in the claimed invention (emphasis added).

Wang and Yamazaki, alone or in combination, also fail to teach or suggest that "said oxide layer has a first oxide portion of a first thickness over said spacers and a second oxide portion over said source/drain regions of a second thickness, said first thickness being about 60% of said second thickness," as independent claim 40 recites. None of Wang and Yamazaki discloses, teaches or suggests an oxide layer formed "by oxidizing approximately an entire upper surface of said source/drain region using atomic oxygen," much less "an oxide layer . . . by oxidizing approximately an entire upper surface of said source/drain region using atomic oxygen" and having "a first oxide portion of a first thickness over said spacers and a second oxide portion over said source/drain regions of a second thickness, said first thickness being about 60% of said second thickness," as in the claimed invention.

B. No Suggestion or Motivation to Combine the References Exists

Courts have generally recognized that, to establish a *prima facie* case of obviousness, "[i]t is insufficient that the prior art disclosed the components of the

patented device, either separately or used in other combinations; there must be some teaching, suggestion, or incentive to make the combination made by the inventor." Northern Telecom, Inc. v. Datapoint Corp., 908 F.2d 931, 934 (Fed. Cir. 1990). This way, "the inquiry is not whether each element existed in the prior art, but whether the prior art made obvious the invention as a whole for which patentability is claimed." Hartness Int'l, Inc. v. Simplimatic Engineering Co., 819 F.2d 1100, 1108 (Fed. Cir. 1987). Accordingly, a determination of obviousness "must involve more than indiscriminately combining prior art; a motivation or suggestion to combine must exist." Pro-Mold & Tool Co., 75 F.3d at 1573. This way, a rejection of a claim for obviousness in view of a combination of prior art references must be based on a showing of a suggestion, teaching, or motivation that has to be "clear and particular." In re Dembiczak, 175 F.3d at 999. Thus, the mere fact that it is possible to find two isolated disclosures which might be combined to produce a new process does not necessarily render such process obvious, unless the prior art also suggests the desirability of the proposed combination.

The April 6, 2005 Office Action fails to establish a *prima facie* case of obviousness because, as the Court in Northern Telecom, Inc. noted, "[i]t is insufficient that the prior art disclosed the components of the patented device" and there is no "teaching, suggestion, or incentive to make the combination." Northern Telecom, Inc., 908 F.2d at 934. On one hand, the crux of Wang is "fabricating a (DRAM) having T or Y shaped capacitor with a high density and capacitance." (Col. 2, lines 32-34). For this, Wang teaches "fabricating a T or Y shaped capacitor which has less photolithographic and etch steps than the conventional processes." (Col. 2, lines 28-31). On the other hand, Yamazaki relates to the formation of a "modified silicon oxide film . . . used as the gate insulating" (col. 3, lines 22-23) which is subjected to an anneal treatment "at 400° to 700° C., preferably 450° to 650° C. in a highly reactive atmosphere of nitrogen oxide which is photoexcited or photodecomposed by ultraviolet rays." (Abstract).

Yamazaki emphasizes that "[n]itrogen oxide is made reactive by irradiation with ultraviolet rays, and the resulting reactive nitrogen oxide . . . reacts with the gate insulating film" (col. 6, lines 17-25) and points out that the annealing temperature "is not for the decomposition of the nitrogen oxide but for the penetration of active atoms and molecules into the silicon oxide film." (Col. 6, lines 28-32).

Thus, it is clear that the only element which Wang and Yamazaki have in common is their substrate on which their respective structures are formed. In addition, a person of ordinary skill in the art would not have been motivated to combine Wang, which teaches T or Y shaped capacitor for high density and capacitance, with Yamazaki, which teaches a specific anneal treatment of an oxide layer to be used as a gate insulating layer.

Applicants also note that courts have held that "[i]f the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious." M.P.E.P. § 2143.01 (citing In re Ratti, 270 F.2d 810, 123 U.S.P.Q. 349 (CCPA 1959). This is because the "suggested combination of references would require a substantial reconstruction and redesign of the elements shown in [the primary reference] as well as a change in the basic principle under which [the primary reference] construction was designed to operate." In re Ratti, 270 F.2d at 813, 123 U.S.P.Q. at 352.

In the present case, employing the gate insulating film technique of Yamazaki *in lieu* of the method of forming the oxide layer 22 of Wang, as the Office Action suggests, "would require a substantial *reconstruction* and *redesign* of the elements shown in [Wang]." (emphasis added). First, the suggested combination of Wang and Yamazaki would have to change the composition of the insulation layer 22 of Wang

"formed of silicon nitride and undoped silicon oxide," as Yamazaki teaches only a "nitrogen oxide" that requires a subsequent annealing step. Second, there is no indication that the annealed nitrogen oxide employed as <u>the gate insulating film</u> of Yamazaki would actually operate *in lieu* of the conformal insulating layer of Wang that is provided over the gate stack and over the gate insulating film. In addition, there is no indication that the method of forming the annealed nitrogen oxide of Yamazaki as part of the gate insulating film would be combinable with the method of forming the insulating layer of Wang, which is provided over the gate stack. Specifically, as the "nitrogen oxide" of Yamazaki requires oxidation of a silicon film under specific conditions and followed by an anneal step, the proposed combination would have to eliminate the conventional method of forming the silicon nitride and undoped silicon oxide 22 of Wang, and to replace it with the oxidation of a silicon film under specific conditions to form a nitrogen oxide over the gate stack of Wang. There is nothing in Wang, however, that indicates that the gate stacks of Wang could withstand deposition of a silicon film, followed by crystallization to become an active layer, and subsequently followed by exposure to an atmosphere of dinitrogen oxide, for example, and later by an anneal. Thus, the proposed combination would necessarily redesign and reconstruct the elements of Wang.

Applicants also note that Yamazaki teaches <u>against</u> the formation of an oxide silicon layer at high temperatures. Yamazaki first notes that, in accordance with a conventional process for silicon oxidation, "[f]or the oxidation reaction of silicon to proceed, it is necessary that the atmosphere contain oxidizing atomic oxygen or equally reactive oxidizing molecules" and further explains that "[h]owever, an extremely high temperature is required to convert molecular oxygen into atomic oxygen, and hence thermal oxidation in a dry oxygen atmosphere proceeds only at high temperatures of 1000° C. or higher." (Col. 12, lines 7-14). Yamazaki further describes that "[t]he present

invention is based on the finding that atomic oxygen and ozone (which are obtained by irradiating oxygen with ultraviolet rays for excitation, decomposition, and reaction) or excited oxygen molecules and nitrogen oxide molecules have a sufficiently long life and are capable of spatial movement under adequate conditions." (Col. 12, lines 14-20). In other words, the "invention [of Yamazaki] employs oxygen, ozone, or nitrogen oxide, which has been made reactive by irradiation with ultraviolet rays, for thermal oxidation in a low-temperature reaction chamber into which it is introduced." (Col. 12, lines 20-23). In this manner, "the process of [Yamazaki] permits thermal oxidation to proceed at a lower temperature as compared with the conventional process." (Col. 12, lines 23-27; emphasis added). Thus, it is clear that Yamazaki teaches against thermal oxidation of silicon at high temperatures and, thus, against the method of the claimed invention.

For at least the reasons above, the Office Action fails to establish a *prima facie* case of obviousness, and withdrawal of the rejection of claims 1-5, 7, 8, 10, 11, 13, 14, 17-24, 27, 29-33, 35-43, 46, 48, 49 and 51-56 is respectfully requested.

Claims 9, 25 and 44 are not properly rejected under 35 U.S.C. § 103 as being unpatentable over Wang in view of Yamazaki and further in view of Lands et al. (U.S. Patent No. 3,571,914) ("Lands")

Claims 9, 25, and 44 stand rejected under 35 U.S.C. § 103 as being unpatentable over Wang in view of Yamazaki as applied to claims 1-5, 7, 8, 11, 13-24, 26, 27, 29-43, 46 and 48-56 above, and further in view of Lands. This rejection is respectfully traversed.

Lands relates to a "method for stabilizing a semiconductor device against spuriously induced changes in the conductivity characteristics at the surface of the semiconductor." (Col. 1, lines 58-61). The crux of Lands is "the use of a silicon dioxide

layer formed by the oxidative decomposition of TEOS, by the pyrolysis of TEOS in an inert atmosphere, by the hydrogen reduction of silanes, or by other similar processes wherein the oxide layer may be uniformly doped by the desired stabilizing agent during formation of the oxide layer and stabilization of the surface of a semiconductor device." (Col. 3, lines 27-34).

As noted above, neither Wang nor Yamazaki, whether considered alone or in combination, teach or suggest all limitations of independent claims 1, 21 and 40. Similarly, Lands fails to teach or suggest the formation of an oxide layer by "oxidizing an upper surface of a source/drain region using atomic oxygen at a temperature of about 850 ^{0}C to 1100 ^{0}C" (claim 1) or by "oxidizing approximately entire upper surfaces of said source/drain regions using atomic oxygen so that said oxide layer has a first oxide portion of a first thickness over said spacers and a second oxide portion over said source/drain regions of a second thickness, said second thickness being greater than said first thickness" (claim 21). In addition, Lands fails to teach or suggest forming an oxide layer of a composite barrier layer by "oxidizing approximately an entire upper surface of said source/drain region using atomic oxygen so that said oxide layer has a first oxide portion of a first thickness over said spacers and a second oxide portion over said source/drain regions of a second thickness, said first thickness being about 60% of said second thickness," as independent claim 40 recites.

Lands is also silent about an oxide layer "having a thickness of about 50 Angstroms to about 100 Angstroms" and formed by oxidizing an upper surface of a source/drain region using atomic oxygen, as in the claimed invention.

Applicants also note that a person of ordinary skill in the art would not have been motivated to combine the teachings of Yamazaki with those of Land, as the Office Action asserts. As noted above, the crux of Yamazaki is the formation of a "modified

silicon oxide film . . . used as the gate insulating" (col. 3, lines 22-23) which is subjected to an anneal treatment "at 400° to 700° C., preferably 450° to 650° C. in a highly reactive atmosphere of nitrogen oxide which is photoexcited or photodecomposed by ultraviolet rays." (Abstract). On the other hand, the crux of Lands is the formation of a "phosphorous doped silicon oxide layer." For this, Lands teaches "a silicon dioxide layer formed by the oxidative decomposition of TEOS, by the pyrolysis of TEOS in an inert atmosphere, by the hydrogen reduction of silanes, or by other similar processes." (Col. 3, lines 27-34). Accordingly, a person of ordinary skill in the art would not have been motivated to combine Yamazaki, which teaches a specific anneal treatment with reactive nitrogen oxide of an oxide layer to be used as a gate insulating layer, with Lands, which teaches oxidative decomposition or pyrolysis of TEOS to ultimately form a phosphorous doped silicon oxide layer. For at least these reasons, the Office Action fails again to establish a *prima facie* case of obviousness, and withdrawal of the rejection of claims 9, 25 and 44 is also respectfully requested.

<u>Claims 12, 28 and 47 are not properly rejected under 35 U.S.C. § 103 as being unpatentable over Wang in view of Yamazaki and further in view of Kirimura et al. (U.S. Patent No. 6,383,869) ("Kirimura")</u>

Claims 12, 28, and 47 stand rejected under 35 U.S.C. § 103 as being unpatentable over Wang in view of Yamazaki as applied to claims 1-5, 7, 8, 11, 13-24, 27, 29-43, 46 and 48-56 above, and further in view of Kirimura. This rejection is respectfully traversed.

Kirimura relates to "a thin film forming method and a thin film forming apparatus, in which a deposition gas and a radical material having different dissociation energies are used for forming a thin film." (Col. 2, lines 46-49).

None of Wang, Yamazaki and Kirimura, whether considered alone or in combination, teaches or suggests all limitations of independent claims 1, 21 and 40. Claims 12, 28, and 47 are allowable for at least the reasons stated above for claims 1, 21 and 40, respectively. Therefore, withdrawal of the rejection of claims 12, 28, and 47 is also respectfully requested.

Allowance of the application is solicited.

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Respectfully submitted,

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